REPORT

OF

THE KRISHNA GODAVARI COMMISSION

SUMMARY AND PRINCIPAL RECOMMENDATIONS

MINISTRY OF IRRIGATION AND POWER

TERMS OF REFERENCE

(1) To report on the availability of supplies in the Krishna on the basis of annual flow at Vijayawada and other points taking into account upstream utilisation and allowing for regeneration—

(*i*) for 86 per cent dependability as assumed in 1951;
(*ii*) for 75 per cent dependability; and
(*iii*) for such other criterion of dependability as may be considered appropriate.

(2) To report on the requirements of the projects on the Krishna—

(*i*) in operation in 1951;
(*ii*) as approved by the Government of India for execution;
(*iii*) included in the Plans but not yet approved by the Government of India;
(*iv*) further proposed by the States; and
(*v*) such minor schemes as may have been sanctioned up to March 1961.

(3) To report on the availability of supplies in the Godavari on the basis of annual flows at Dowlaishwaram and other points taking into account upstream utilisation and allowing for regeneration—

(*i*) for 86 per cent dependability as assumed in 1951;
(*ii*) for 75 per cent dependability; and
(*iii*) for such other criterion of dependability as may be considered appropriate.

(4) To report on the requirements of the projects on the Godavari—

(*i*) in operation in 1951;
(*ii*) as approved by the Government of India for execution;
(*iii*) included in the Plans but not yet approved by the Government of India;
(*iv*) further proposed by the States; and
(*v*) such minor schemes as may have been sanctioned up to March 1961.

(5) To report on the feasibility of diverting any surplus supplies in the Godavari to the Krishna indicating the quantity to be diverted and the order of the cost involved.

REPORT

OF

THE KRISHNA GODAVARI COMMISSION

SUMMARY* AND PRINCIPAL RECOMMENDATIONS

General

1. The Krishna and Godavari basins extend over an area larger than France. They cover about 221,000 square miles, more than one-sixth of the entire area of India. They include almost one-fourth (23 per cent) of the culturable area of the country.

Approximately, 72 per cent of the area of Maharashtra, 61 per cent of Mysore, 43 per cent of Andhra Pradesh, 15 per cent of Madhya Pradesh and 11 per cent of Orissa lie in the two basins.

The total population of the two basins is about 60 million; about 80 per cent live in rural areas.

2. The Krishna river system has a drainage area of about 100,000 square miles. Together with its tributaries, it drains about 440 miles length of the Western Ghats—the chief source of the Krishna waters. The main river is about 870 miles long. Two of its tributaries, the Bhima, over 500 miles long, and the Tungabhadra, over 300 miles long, are major rivers in their own rights.

About 44,000 square miles of the drainage basin lies in Mysore, 29,000 square miles in Andhra Pradesh and 27,000 square miles in Maharashtra.

3. The Godavari river system has a drainage area of about 121,000 square miles. Its principal source of supply, in its upper reach, is the relatively small catchment in the Western Ghats and, in its lower reach, the forest covered hills and tablelands in the north-east of the basin. The main river is about 910 miles long. The Manjra and the Pranhita, each nearly 450 miles long, the Indravati, over 350 miles long, and the Sabari, about 260 miles long, are four principal tributaries of the Godavari, each a major river.

Approximately, 59,000 square miles of the drainage basin lies in Maharashtra, 28,000 square miles in Andhra Pradesh, 25,000 square miles in Madhya Pradesh, 7,000 square miles in Orissa and 2,000 square miles in Mysore.

4. For the purposes of this report each of the two river systems have been divided into 12 sub-basins as shown in Table I.

**The full report is in 18 Chapters and is accompanied by three appendices, 37 plates and 18 annexures. The Commission was set up in May 1961 and submitted its report in August 1962. The Commission held several discussions with representatives of the State Governments concerned individually and jointly and travelled about 6,500 miles in the two basins by road.*

5. The political distribution of the drainage basins, as described above, came into effect only from 1st November, 1956.

The portion of the two basins, now in Andhra Pradesh, was, prior to Independence, under the control of the former Madras Presidency, the erstwhile Hyderabad State, a former princely State and a number of *jagirdars;* that in Madhya Pradesh was under the former Central Provinces and the erstwhile Bastar State. The areas now in Maharashtra formed parts of the former Bombay Presidency, the former Central Provinces, the erstwhile Hyderabad State and a number of now defunct princely States. Likewise, the part of the two basins now in Mysore was then distributed between the former Madras Presidency, the erstwhile Hyderabad State, the former Bombay Presidency, the former Mysore State and some defunct princely States. The areas in Orissa were largely in the erstwhile Kalahandi State and in the now defunct Jeypore estate.

6. A serious difficulty which the Commission had to encounter, at all stages of its work, arose out of the fact that general statistics, collected with the district as a unit could not be applied directly to hydrologic units, river basins and sub-basins. The Commission had in such cases to work out approximate figures based on the proportion which the area of a district within the basin bears to the total area of the district. Apart from this, the Commission found an almost complete absence of published statistics relating to the Krishna and Godavari basins. Most of the important data and information relating to water resources development in the two basins were either non-existent or had not been compiled and analysed before. The Commission thus found that one of its important tasks was to get together and compile whatever data it could obtain.

Except, where specifically indicated, the report of the Commission is based on the technical data and other information supplied by the State Governments concerned. The Commission has not carried out any physical verification of these data nor was this considered necessary. The responsibility for the accuracy of these data rests with the State Governments.

7. **The Commission suggests that the possibilities be examined of collecting general statistics, particularly data of land utilisation, by river basins and sub-basins.**

8. Geologically, the two basins consist largely of Archaean formations, parts of which are covered over by Deccan trap lavas, Cuddapah and Vindhyan basins and faulted blocks of the Gondwanas.

While the mountains are mere outstanding portions of the old plateau that have escaped the weathering of ages, the rivers have flat shallow valleys with relatively low gradients, the channels having approached the base level of erosion.

Apart from the slopes of the Western Ghats, the irregular ranges of the Eastern Ghats and the table-lands in the north-east of the Godavari basin, the entire drainage basin of the two rivers, comprises undulating country, a series of ridges and valleys interspersed with low hill ranges.

9. The soils are, in general, relatively shallow specially where they are formed *in situ.* Deep soils are found mainly along the banks of streams and rivers where

they have been formed by eroded material brought by and deposited during floods. The typical soil features, in the two basins and the texture and properties of the top soil as well as of the sub-grade have been described.

Land and water utilisation

10. The gross area of the two basins as per village papers, is about 141 million acres. Of this, about 29 million acres are forests, largely undeveloped. About 99 million acres are culturable, out of which 73 million acres are under cultivation. The area cropped annually is about 76 million acres. The irrigated area is about 7·7 million acres, the irrigated cropped area every year is about 9 million acres. The latter includes about 1·9 million acres irrigated from the two rivers outside their drainage basins.

Of the irrigated area of about 7·7 million acres, about 1·9 million acres are irrigated by wells and other sources, about 2·5 million acres by tanks and 3·3 million acres by canals.

11. The major crops grown in the two basins, in descending order of the acreage covered, are *jowar* (23 million acres), paddy (9 million acres), cotton (7 million acres), ground-nut (6 million acres), *bajra* (5 million acres), wheat (3 million acres), and sugarcane and perennials (1 million acres).

Under irrigated conditions, paddy is the principal crop (6 million acres).

12. The total installed capacity of hydro-electric generating plants in the two basins, as in March 1961, is about 500,000 kW, that of thermal plants about 100,000 kW. The basins are rich in minerals but the level of exploitation is relatively modest.

13. The enormous forest wealth in the Krishna and Godavari basins has largely remained neglected; the level of exploitation is low. The development of power has so far been poor and the present industrial development is only a modest indication of the large potential which remains to be developed. Under these conditions, the economy of the two basins and adjoining areas depends largely on agriculture, which provides a low level of subsistence except in a small part where facilities for irrigation have been provided. The well-being and prosperity of the entire Krishna-Godavari region is closely related to the development of water resources of the two river basins.

14. Some parts of the Krishna and Godavari basins suffer from frequent failure of rainfall during critical periods in the agricultural rotation. Scarcity conditions then prevail, land revenue is suspended and other relief measures are taken. A study of these areas has been made, *taluk*-wise.

The Commission has found that there are 34 *taluks* in which 75 per cent or more of the annual land revenue was suspended at least twice in a 10-year period or 50 to 75 per cent of the annual land revenue was suspended at least thrice in a 10-year period. The normal-annual yield of crops in these *taluks* is also low. Three of these *taluks* are in the Anantapur District of Andhra Pradesh, three in Madhya Pradesh, nine in the districts of Sholapur, Poona and Ahmednagar in Maharashtra and 19 in various districts of Mysore.

15. The source of all water in the Krishna and Godavari basins, whether in stream flow or in the form of ground waters, is the rain which falls within each basin. There is no evidence of any sub-soil flow getting into the basin from outside or of any sub-soil flow escaping from either of the two basins.

16. There are 374 rain-gauge stations in the Krishna and Godavari basins for most of which rainfall data over a period of 50 years are available. An examination of the distribution of these rain-gauge stations, sub-basinwise, shows that there are large tracts with no rain-gauge station at all.

17. **It is necessary to review the number and distribution of rain-gauge stations in the two basins and to establish new stations to fill in such gaps as exist. It is also important that the daily rainfall data for all these stations should be published on a monthly basis by sub-basins. Machinery should be established for a regular study and analysis of these data.**

18. The Krishna and Godavari basins receive most of their rainfall during the south-west monsoon, from June to September. The high rainfalll zone along the Western Ghats forms the western boundary of the two basins for more than 500 miles. The other high rainfall area is the forest covered hills and table-lands in the north-east of the Godavari basin. For the rest, the two basins constitute low rainfall zones. There is a large belt, about 45,000 square miles in area, a short distance east of the Western Ghats, varying in width from about 160 miles in the south of the Krishna basin to about 60 miles in the north of the Godavari basin, where the normal annual rainfall is less than 600 mm (about 24 inches).

At the request of the Commission, the India Meteorological Department has prepared maps showing the incidence and distribution, over the two basins, of seasonal and annual normal rainfall. These maps are annexed to the report.

19. The weighted average annual rainfall of the Krishna basin is about 31 inches and about three-fourths of it occurs during the four months, June to September.

The weighted average annual rainfall of the Godavari basin is about 45 inches, of which as much as 84 per cent occurs during the four months, June to September.

Apart from the fact that most of the rainfall is concentrated in the four months, June to September, there is a wide variation in its incidence, in time and space. This variation is more marked in the low rainfall zone than in areas of high rainfall and more in the relatively dry part of the year than in the wet months. The north-east monsoon is much less dependable than the south-west monsoon.

The areas lying towards the south-east of the Krishna basin receive a large proportion of their annual rainfall during the north-east monsoon. They do not get any dependable rainfall from either the south-west or the north-east monsoon.

Evaporation

20. Little observed data is available regarding evaporation but, from the prevailing meteorological features, it is known that both the basins are areas of very high evaporation. During the three months preceding the rainy season, March to

May, evaporation rates are very high and the potential evaporation for this period is almost half of the total annual potential evaporation.

21. **It is necessary to establish an extensive network of evaporation measuring stations, throughout the two basins, particularly at the sites of existing and proposed reservoirs.**

22. No information is available about evapo-transpiration in this region. Since this is the most important element in the water requirements of crops, the lack of this data is a serious lacuna in the data required for the optimum development of the water resources of the two basins.

23. **Systematic observation of evapo-transpiration under various crops needs to be carried out in selected stations throughout the two basins.**

River flow

24. In general, the rivers rise in the later half of June. July and August are the months of maximum discharge; the volume of flow in these two months varies from 40 to 85 per cent of the annual flow.

The volume of flow during the six months, June to November, is 90 to 100 per cent of the annual flow; after January the rivers are practically dry.

25. There has so far been no planned and systematic observation of discharges on either the Krishna or the Godavari river systems and the position with regard to sediment data is worse. In general, the only systematic records that are available pertain to existing anicuts or reservoirs where river flow is calculated on the basis of gauge readings observed from different parts of the works.

Since the reliability of river discharge data is closely related to the methods of observation and/or estimation of discharge, the Commission made special efforts to ascertain these methods. The information obtained has been set out fully in the Annexures to this report along with the data.

At some of the sites for which data are available, the method of observation indicates that these data cannot be relied upon for any purpose. At other sites, the data can be taken as approximately correct, within 20 per cent, plus or minus, of the actual.

26. Of the 62 sites on the Krishna river system for which some data have been supplied, useful data are available for a period of 10 years or more for only 15 sites and for a period of 20 years or more for only 5 sites.

On the Godavari river system, out of 44 sites for which data have been made available, useful data for a period of 10 years or more are available for only 16 sites and for a period of 20 years or more for only 7 sites.

It is surprising to note that the observations being made at some of these sites were discontinued only during 1959 and 1960.

27. Because of the uneven distribution of the discharge sites, there are many sub-basins for which no river flow data exist. From the point of view of development of

large river systems like the Krishna or the Godavari, there are several important considerations, which it is not possible to study unless a comprehensive system of discharge observations is established and data for a fairly long period are collected. One of these considerations is transit losses or the reduction in river flow by evaporation or otherwise from one point on the river system to another. Another is time lag, or the time taken by the water in travelling from one point on the river system to another. Re-generation or the seepage into the river from the sub-soil water on both sides is another important element. As a result of new irrigation developments this regeneration is bound to increase. The quantum of increase cannot, however, be estimated at this stage. In addition there will be some salvage of the transit losses which now occur. No quantitative values can, however, yet be assigned.

28. With river supplies varying from year to year, an important consideration in planning is the measure of dependability which should be adopted for purposes of development—the higher this dependability, the lower the overall use and the lower this dependability, the more the overall use. As a result of its discussion with the representatives of the State Governments concerned, the Commission has made recommendations with a view to using the varying river supplies to best advantage.

29. **The Commission strongly recommends, as a matter of first urgency, the establishment on a permanent basis and on scientific lines, of daily discharge observations at 38 sites of the Krishna River System and 38 sites on the Godavari River System. The river flow data to be obtained at these sites are essential for the preparation of individual projects, for the preparation of an integrated basin-wide plan, for the subsequent operation of such a plan and the regulation, to best advantage, of the available river waters in any year.**

30. **As a number of dams are being constructed in these river basins, it is necessary that, besides taking discharge observations, systematic data should also be collected with regard to the sediment carried by river waters. These data would be of considerable use in the design of the dams and in estimating the probable life of reservoirs.**

31. **The Commission regards the collection of river discharge and sediment data as a fundamental work of national stock-taking and recommends that, like meteorological data and general surveys, the Central Government should assume the responsibility for this important work and set up a special organisation for this purpose under the Ministry of Irrigation and Power.**

32. It is unfortunate that no attempt has so far been made to undertake regular discharge observations at the sites of proposed projects. Even for the projects under construction, little attention has been paid to the observation and compilation of accurate flow data.

For project planning, river flow is estimated by various empirical formulae. The Commission is unable to support this procedure and consider this practice unsound.

Considerable caution is called for in undertaking any new project on this basis.

33. It needs to be stated that for most projects it is not enough to know the average annual yield at the point of diversion; its distribution during the year and its variation, from year to year, are equally important.

Because of this it is necessary to formulate detailed rules for each project laying down the manner in which river flow will be withdrawn, or abstracted for storage, during any part of the year, under varying conditions of river supply. The operation of all projects in different States will have to be carried on in a co-ordinated manner (see also paragraph 53 *infra*).

34. **The Commission regards it indispensable, that in addition to the work outlined in paragraphs 29 and 30 above which should be undertaken by the Central Government, arrangements should be made by each State Government**

(*a*) **to make accurate measurements of the daily withdrawals by all major irrigation canals and power channels and an estimate, from gauge discharge curves of the withdrawals by other canals and power channels; such gauge discharge curves to be regularly checked and kept up-to-date;**

(*b*) **to measure river flow and prepare 'water accounts' at the sites of all storage projects and diversion weirs in operation; and**

(*c*) **as soon as a new project is conceived, to set up as a first priority, regular discharge and sediment observations at that site.**

It will be necessary to establish a close co-ordination between the above work to be done by the State Governments and the work to be done by the Central Organisation proposed in paragraph 31 above.

Ground waters

35. No systematic ground water surveys of the Krishna and Godavari basins appear to have been carried out so far. No data and statistics in this respect are, therefore, available. There are, however, 335,000 wells in the Krishna basin irrigating about 1.13 million acres and 303,000 wells in the Godavari basin irrigating about 0.73 million acres. There are indications of good ground water characteristics in the sub-soil in the coastal belt and along the lower Godavari Valley and the lower Pranhita. Another important source of ground waters would be the seepage from canals and from irrigated fields.

36. There is a water balance between the rainfall on the one hand and stream flow, ground waters, evaporation and transpiration by crops and native vegetation on the other. Also, accretions to ground water from rainfall, from seepage, from irrigation channels and from irrigated fields, unless withdrawn through wells or by pumps will, under good sub-surface drainage conditions, seep into the rivers; under other conditions, these waters will fill pockets, form perched water tables and may cause local water-logging.

37. **It is important that regular observations should be made by all State Governments of the position of the ground waters and their fluctuations during the year. The methods to be adopted would vary in different parts according to local conditions. This information is necessary to maintain a close watch on the behaviour of ground waters, particularly in view of the large scale new developments undertaken and contemplated, and for the due exploitation of ground waters, separately or in conjunction with canals.**

Developments up to 1951

38. The nature and extent of irrigation developments in the Krishna and Godavari basins as in 1951, are shown in Tables II and III respectively. It will be seen that there were only three major* schemes and 17 medium* schemes in the Krishna basin and five major schemes and 20 medium schemes in the Godavari basin in operation in 1951. There were, in addition, a large number of minor* schemes and numerous tanks and small diversions* in each basin.

Important particulars, to the extent available, of each major and medium scheme given in Annexures to the report. These Annexures also show the available particulars of each minor scheme and district-wise figures for small tanks and diversions.

39. The withdrawals by major and medium schemes, as supplied by the State Governments, are shown in Annexures to the report. No information is available regarding the amount of water diverted by small tanks and diversions. The Commission has, therefore, made rough estimates of the diversions by these small works.

40. The State-wise development of irrigation in the two basins, in 1951, was as follows:—

State	*Average annual irrigation*			*Average annual diversion*		
	Major and medium schemes	*Minor Schemes, tanks, etc.*	*Total*	*Major and medium schemes*	*Minor Schemes, tanks, etc.*	*Total*
	....Million acres.............			*......T.M.C.†..............*		
	Krishna River System					
Andhra Pradesh	1·26	0·35	1·61	231·1	59·0	290·1
Maharashtra	0·20	0·02	0·22	41·9	1·1	43·0
Mysore	0·06	0·41	0·47	11·3	67·0	78·3
Total . .	**1·52**	**0·78**	**2·30**	**284·3**	**127·1**	**411·4**
	Godavari River System					
Andhra Pradesh	1·39	0·52	1·91	306·3	86·5	392·8
Madhya Pradesh . . .	0·08	0·12	0·20	7·9	12·3	20·2
Maharashtra	0·19	0·42	0·61	32·7	23·3	56·0
Mysore	—	—	—	—	0·2	0·2
Orissa	—	0·02	0·02	—	1·4	1·4
Total . .	**1·66**	**1·08**	**2·74**	**346·9**	**123·7**	**470·6**
Grand Total Krishna and Godavari River Systems	**3·18**	**1·86**	**5·04**	**631·2**	**250·8**	**882·0**

**For purpose of this report, a major scheme is one intended for annual irrigation of* 50,000 *acres* o *more and any power project; a medium scheme is one intended for annual irrigation of less than* 50,000 *acre but having a culturable commanded area or ayacut of not less than* 5,000 *acres; a minor scheme is one havin a culturable commanded area or ayacut of less than* 5,000 *acres but not less than* 500 *acres; a smal tank or diversion is a scheme having a culturable commanded area or ayacut of less than* 500 *acres.*

†T.M.C. means one thousand million cubic feet i.e., 1,000,000,000 *cubic feet.*

41. Three hydro-electric projects in Maharashtra, owned by private companies and having an installed capacity of 274,000 kW. used 38.0 T.M.C. of water which was diverted into the Arabian Sea. On the Godavari, there was no hydro-electric power development.

42. Evaporation losses from reservoirs take a substantial toll from the available river supplies in the Krishna and Godavari basins. In comparison with the diversions for irrigation, these losses are comparatively very high where the tanks are shallow as generally happens to be the case.

For the major and medium schemes in operation in 1951, the estimated reservoir losses were 13.3 T.M.C. on the Krishna and 12.8 T.M.C. on the Godavari. For minor schemes, these losses have been estimated as 105 T.M.C. on the Krishna and 145 T.M.C. on the Godavari; these are more than the waters applied to irrigation by these schemes.

43. The position regarding statistics for tanks is far from satisfactory. There are nearly 60,000 tanks in the two basins irrigating approximately 1.66 million acres and the estimated diversions by them are of the order of 220 T.M.C. Unless systematic long term data regarding these tanks are collected, their effect on river flow cannot be determined.

The Commission recommends that important data for individual tanks should be collected and an up to-date record maintained. The area irrigated annually by each tank should be measured and recorded, together with an estimate of the quantity of water applied to irrigation.

A survey of each tank should be carried out periodically, say, every five years, to watch the loss in capacity, if any.

44. A number of drains had been constructed in the two deltas as well as on some of the major projects in Maharashtra. No discharge data are, however, available for these drains.

The Commission recommends that discharges of drains should be observed regularly and the data compiled.

Working statistics of canals and distributaries

45. There is no system of maintaining operation statistics of canals and distributaries. These statistics are absolutely necessary for watching the performance and efficiency of the canal systems.

The Commission is of the view that complete working statistics of canals and distributaries should be compiled annually and printed in a suitable form so as to be available as a permanent record for future reference.

Development since 1951

46. Developments since 1951 fall into two categories: Projects and schemes which have come into operation before March 1961, even though partially, are shown in Tables IV and V. In addition, there have been some improvements on pre-1951

projects; these have been mentioned in the report. Projects and schemes, under construction are shown in Table VI and VII. Particulars of all these Projects and schemes are given in the Annexures to the report.

47. The overall, State-wise, position* of the developments undertaken since 1951, as compared with the developments up to 1951, is as follows :

State	*Average annual irrigation*			*Power installed*			*Average annual diversion*		
	up to 1951	*since* 1951**	*Total*	*up to* 1951	*since* 1951	*Total*	*up to* 1951	*since* 1951	*Total*
	....Million acres....			......Megawatts....			......T.M.C......		
			Krishna River System						
Andhra Pradesh .	1·61	2·74†	4·35	—	90‡	90	290·1	503·5§	793·6
Maharashtra . .	0·22	0·42	0·64	274	585	859	81·0	129·9	210·9
Mysore . .	0·47	1·40	1·87	—	33	33	78·3	120·4	198·7
Total .	**2·30**	**4·56**	**6·86**	**274**	**708**	**982**	**449·4**	**753·8**	**1,203·2**
			Godavari River System						
Andhra Pradesh .	1·91	0·35	2·26	—	250	250	392·8	27·5	420·3
Madhya Pradesh .	0·20	0·09	0·29	—	—	—	20·2	4·9	25·1
Maharashtra . .	0·61	0·68	1·29	—	15	15	56·0	87·5	143·5
Mysore . .	—	—	—	—	—	—	0·2	—	0·2
Orissa . .	0·02	0·08	0·10	—	—	—	1·4	7·8	9·2
Total .	**2·74**	**1·20**	**3·94**	—	**265**	**265**	**470·6**	**127·7**	**598·3**
Grand Total Krishna and Godavari .	**5·04**	**5·76**	**10·80**	**274**	**973**	**1,247**	**920·0**	**881·5**	**1,801·5**

48. It would appear from the above that the works undertaken since 1951 will create an irrigation potential much more than had been built up to 1951, during the previous 100 years or more. On the Krishna, the annual irrigation from projects and schemes undertaken since 1951 would be twice the area irrigated as in 1951; on the Godavari these works will increase the irrigated acreage by about 44 per cent.

**Based on particulars of Projects as furnished in each case by the State Government in whose territory the project is located.*

***includes improvements effected up to* 1961 *on pre-* 1951 *projects.*

†*includes Mysore's share of irrigation in Tungabhadra, Rajolibanda and Tungabhadra High Level Canal—Stage I.*

‡*includes Mysore's share of power in Tungabhadra Project and Tungabhadra Hydro Electric Scheme-Stage II.*

§*includes Mysore's share of annual diversion in Tungabhadra, Rajolibanda and Tungabhadra High Level Canal—Stage I.*

The hydro-electric potential to be developed by these projects, though more than in 1951, is still relatively small, particularly on the Godavari.

49. It will, however, take many years more* before the potential being created by the developments undertaken since 1951 will be fully developed. Against a total annual irrigation of 5.43 million acres to be developed by these works the area actually irrigated in 1961 was only 0.71 million acres or about 13 per cent. Considerable work has yet to be done and a vast expenditure to be incurred first on the construction of the engineering works and then on the development of the land.

In the view of the Commission, construction work is not proceeding at the optimum rate and relatively little effort is being made for speeding up development. Meanwhile interest charges on the expenditure already incurred keep on accumulating and adding to the cost of development.

50. **The Commission recommends strongly that an immediate review be made of the developments undertaken since 1951, in each State, in order to ascertain how the construction of the engineering works can be expedited to attain the optimum rate of development on each work. Such additional funds (including foreign exchange) and such personnel, as may be required should be allocated to these projects in preference to any new project. New projects should be sanctioned only if men, material and money are available surplus to the requirements of the projects already undertaken†.**

51. The cost of irrigation development in the Krishna and Godavari basins is relatively high, varying from about Rs. 500 to Rs. 1,300 per acre irrigated. This high cost is attributable in part to the fact that the supplies made available are proposed to be utilised over a relatively small area or canals are proposed to be run with full capacity or near full capacity only for a few months during the year.

It is necessary that the crop pattern on these projects should be reviewed and the irrigation facilities provided spread over a larger area and to a larger number of cultivators (also see paragraph 68).

52. From the point of view of river supplies, most projects undertaken since 1951 have been planned and are being executed as independent units without regard to other projects, existing or proposed, in the basin. Accordingly, each such project assumes for itself the highest priority on all waters reaching the project site and there has been no examination of the hydrological consequences of its operation on the works downstream.

53. **The Commission recommends that the effect of each project undertaken since 1951 on the supplies available for projects downstream of it should be examined, the relative priorities on river flow for each project determined and, where necessary and to the extent now possible, the design of each project should be revised to comply with the requirements of integrated operation.**

**For instance, (i) Rajolibanda Diversion Scheme costing Rs.* 4·5 *crores was taken up in* 1944, *and came into partial operation* 14 *years later in* 1958. *Irrigation developed up to* 1961 *was only* 21 *per cent; (ii) Bhadra Reservoir scheme costing nearly Rs.* 36 *crores was taken up in* 1947 *and came into partial operation in* 1957. *Development up to* 1960-61 *was only* 7 *per cent; (iii) Gangapur Scheme, costing nearly Rs.* 5 *crores, was taken up in* 1948. *It came into partial operation in* 1957. *Development upto* 1961 *was only* 12 *per cent.*

†*For proposals to increase the speed of development, see paragraphs 68 and 72 to 75.*

54. Not much attention has been paid to the requirements of drainage operations that may be required in the wake of new irrigation developments. These require an early appraisal.

New projects and adequacy of river supplies therefor

55. A large number of new projects and schemes have been put forward by the State Governments concerned. These fall in two categories: those which have been referred to in III Plan (some are included in III Plan, others are still under consideration) and those not referred to in III Plan. All these have been described in Annexures to the report.

In all, the Commission has received particulars of 81 proposed major and medium projects on the Krishna and of 156 such projects on the Godavari; 92 minor schemes on the Krishna and 632 minor schemes on the Godavari are contemplated. There are, of course, a number of small tanks and diversions in addition.

The overall position, State-wise, with regard to these new schemes and projects is as follows :--

Name of State	*Proposed power installed (million kW)*	*Proposed annual irrigation (million acres)*	*Proposed annual diversion (T.M.C.)*	*Average* delta (feet)*
Krishna River System				
Andhra Pradesh	1·34	6·06	1,258·5	4·8
Madras	—	1·78	206·3	2·7**
Maharashtra	1·83	3·15	550·1†	2·4
Mysore	—	5·11	762·5	3·4
Total . . .	**3·17**	**16·10**	**2,777·4†**	
Godavari River System				
Andhra Pradesh	2·12	5·26	1,137·0	5·0
Madhya Pradesh	1·27	4·22	402·3	2·2
Maharashtra	0·44	5·24	471·0	2·1
Mysore	—	0·16	27·9	4·0
Orissa	0·43	1·31	193·9	3·4
Total . . .	**4·26**	**16·19**	**2,232·1**	

**Average for all irrigation projects proposed by each State.*

***Excludes the supplies to be received from the existing source of supply mainly local tanks, for part of the area.*

†*Includes supplies proposed to be diverted westward for power generation.*

56. While most of the projects and schemes mentioned above are based on topo-sheet studies only in some cases with preliminary reconnaissance of the diversion or storage site, they differ widely in their concept and the diversions proposed are not directly comparable.

So far as irrigation projects are concerned, this concept can best be indicated by the large range in the figures shown above of average delta or the quantity of water proposed to be diverted per acre irrigated. This range would be still larger if one would examine individual projects of each State.

So far as power projects are concerned, they are, in some cases, situated in the supply line of an irrigation canal, requiring no additional diversion; in other cases, they would deliver into the river below the power house a regulated supply of water from the tail-race. There are, however, 10 power projects of Maharashtra which would divert to the Arabian Sea 226.5 T.M.C. of water out of the Krishna basin and one power project of Orissa which would divert 25.1 T.M.C. of water from the Godavari basin.

57. The engineering and economic feasibility of most of the projects has yet to be established; detailed field investigations would have to be undertaken for each such project. *Primafacie* some of the projects which required the construction of dams, two or three miles long, and large spillways to store only one or two T.M.C. of water would not seem to be practical propositions. In case of some other projects, it is doubtful whether it would be possible for the land to deal with all the water proposed to be put on it. By and large, the State Governments have put forward these projects on the tacit assumption of unlimited funds being available and assuming for each project the highest priority on the available flow at the site of the project without consideration of the requirements of other projects on the river system.

While the Commission did not examine individual projects, it is apparent that there would be little possibility of generating any power at Pochampad on the Godavari; also the hydrological features of the river would indicate that no irrigation canal from Pochampad would be feasible unless it is based on storage. As regards water supply for Madras City, the Commission has come to the conclusion that the best and most economical source for it would be the Krishna.

58. A number of projects have been put forward jointly by two State Governments. There are others which, although sponsored by only one State Government, would submerge large areas in the territory of another State. There is still another class of projects put forward by different States, which impinge on each other. Some of these are dependent on the same supply of water; others on the same storage site and still others, if executed would drown the tail-race waters of an upper power project. Accordingly the totals of "proposed power installed", "proposed annual irrigation" and "proposed annual diversion" shown under paragraph 55 above are likely to be substantially more than the practical potentialities of the two river systems.

59. The requirements of the new projects and schemes, as put forward by the State Governments, have been examined sub-basin-wise, in the context of rough estimates of the river supplies likely to be available in the sub-basin and the diversions by projects in operation or those undertaken since 1951. The overall result is presented in Table VIII.

Briefly stated, the supplies available in the Krishna basin and in the upper part of the Godavari basin (sub-basins G.1 to G.5) are inadequate to meet the demands of the projects put forward by the State Governments; the supplies available in the lower part of the Godavari basin (sub-basins G. 7to G.12) are in excess of the demands.

60. Among the projects referred to in paragraph 58 which impinge or are dependent on one another, the most important are four power projects and five irrigation-*cum*-power projects in the lower Godavari area, in sub-basins G. 9, G. 10, G. 11 and G. 12 proposed by Andhra Pradesh, Madhya Pradesh, Maharashtra and Orissa.

These projects have a large hydro-electric potential; only an integrated scheme can develop this potential to best advantage. A regulated supply of water from an upper power project can successively be used on a number of downstream power projects. The full reservoir levels and tail-race levels at each project site have to be so fixed as to get maximum benefit of the gross head available.

61. A large part of the regulated flow available in the river Godavari from the power projects referred to above, which would amount to much more than 10 M.A.F., would be surplus to the requirements of projects on the Godavari and can be diverted to the Krishna basin, to the extent these supplies can be utilised in that basin by the following two link canals :

(*a*) A link canal from the Godavari at Polavaram to Vijayawada at a cost of about Rs. 40 crores. This can transfer usefully about 211 T.M.C. (4.8 M.A.F.) of water to the Krishna.

(*b*) A link canal from the Godavari near Albaka or Singaraddi to Pulichintala on the Krishna at a cost of about Rs. 40 crores. This link canal can transfer usefully about 95 T.M.C. (2.2 M.A.F.) of water to the Krishna.

It may also be possible to make up the shortage in the upper Godavari area, to some extent, by the transfer of about 25 to 30 T.M.C. of water from the Penganga to the Godavari. The cost of this link canal has not been estimated.

62. These diversions, if executed, would call for modifications in some of the projects under execution and in some of those proposed (see paragraph 63 below). These modifications and the overall effect of the transfer of water as proposed above, have been described in the report.

63. In the light of the facts and considerations set out above the Commission recommends as follows :

(*a*) **Immediate steps be taken to prepare an integrated plan incorporating the power and irrigation developments proposed by different States in the lower Godavari area (see paragraph 60 above) and the, Polavaram-Vijayawada Link and the Godavari-Pulichintala Link (proposed in paragraph 61 above). It should be possible on the basis of the information contained in this report, field reconnaissance and some preliminary surveys to be carried out, to prepare a preliminary project report in about six months and establish the feasibility, or otherwise, and scope of the proposed diversions from the Godavari to the Krishna.**

As soon as this preliminary project report has been prepared, final decision can be taken in regard to :

(*i*) the scope of the Nagarjunasagar Project in the light of the diversions from the Godavari;

(*ii*) sanction to or abandonment of the Nagarajunasagar Hydro-electric Project; and

(*iii*) the scope of the Srisailam Project.

It is clear that the Srisailam Project would fit in any scheme and from this point of view, there should be no objection to starting work on the Srisailam Project, the only hydro-electric development left in the lower Krishna area. The scope of the project would, however, have to be reviewed as soon as the preliminary plan mentioned above has been prepared.

In view of the regulated supplies that would be available to the projects, existing and proposed, on the Krishna below Nagarjunasagar, from the Godavari diversions, and to the canals at Nagarjunasagar, from Srisailam, the crop pattern now proposed on the basis of 4 to 6 months' supply should be revised to take advantage of the regulated flow.

(*b*) **A preliminary survey be made of the proposed Penganga-Pochampad Link and this survey be taken into account before according sanction to the Penganga Hydro-electric Project.**

Administration and management

64. There are wide variations in the scope and the provisions of existing legislation on irrigation development applicable to different States and different regions of each State in the Krishna and Godavari basins. Apart from the lack of uniformity, there are serious lacunae in some of the Irrigation Acts, both with regard to the powers necessary for Government for the optimum utilisation, in the public interest, of the available water resources as well as in the obligations of the cultivators, with regard to construction and maintenance of water-courses. An important provision, which does not appear adequately in any existing legislation, is with regard to the obligation of the irrigator to prepare his land for receiving irrigation waters. Such a provision is important for the Krishna and Godavari basins.

65. There is a multiplicity of departments under the State *Government dealing with irrigation development. The Public Works Department, the Revenue Department, the Agricultural Department, Village *Panchayats*, *etc*., all have some role to play. The Dandakaranya Development Authority has its own independent organisation. This division of responsibility ignores the hydrologic unity of river basin and the need of the close coordination between interdependent developments by works of different classes.

**Even at the Centre, the major and medium projects are dealt in the Ministry of Irrigation and Power and minor projects in the Ministry of Food and Agriculture. The Dandakaranya Development Authority is under the supervisory control of the Ministry of Works, Housing and Rehabilitation.*

The Public Works Department, required to construct and operate all major and medium works, do not in some States have any real contact with the irrigators. Development is slow and the overall water use not efficient.

66. Because of the history and nature of development of irrigation in the Krishna and Godavari basins and the relatively large quantities of water so far available when compared with the uses developed, there has not been any urge in the past towards an economic use of river supplies. The control exercised by Government in sanctioning the use of water and in regulating crop pattern themselves stand in the way of economy in water used. Irrigation practices are such as consume a large quantity of water.

The system of 'localisation' introduced in some States is inequitable in as much as it deprives some eligible cultivators from the right to benefit from irrigation facilities while enabling others to use relatively large quantities.

Water-rates vary enormously and are, in most States, un-related both to the present-day costs of construction and maintenance of irrigation works and to the present-day benefits derived by the cultivators from the use of irrigation waters. These rates are in strange contrast to the keenness and the enthusiasm with which more and more irrigation works are in demand in the two basins.

Need for a new policy

67. In the entire Krishna basin and the upper part of the Godavari valley, **water is a scarce natural resource**. Water is also scarce in the adjoining areas lying towards the south-east of the Krishna basin. At the same time, **irrigation waters are an expensive commodity**. Because of the hydrological features of the two rivers, almost every project has to be based on storage. Because of the terrain, canal construction is more expensive than in the Indo-Gangetic plains or the coastal belts.

Evaporation losses from storage reservoirs and tanks are high, particularly during the three months preceding the south-west monsoon. The problem is very serious on small shallow tanks, where the water lost by evaporation may equal or exceed that applied to crops.

Most of the land in the two basins is either cropped or bears forests and natural vegetation. The benefits from an irrigation project would, therefore, be the difference between the value of crops sown after irrigation supplies are made available and the value of forests or crops under un-irrigated conditions. Correspondingly, consumptive use on account of irrigation would be the difference between the evapo-transpiration from the area respectively under irrigated and un-irrigated conditions.

Because of the rolling terrain and spasmodic rainfall of high intensity, soil conservation, and proper land utilization must be regarded as important activities in the two basins, having a significant effect also on their water supplies.

Land treatment is an essential pre-requisite to the introduction of irrigation in most parts of the two basins.

The structure and nature of the soil varies widely in different parts of the two basins and within each river valley. A change-over from un-irrigated to irrigated conditions, therefore, requires expert supervision.

Hydrologically, river flow and ground waters are both parts of a common source of supply and there must, therefore, be a close co-ordination between the developments from surface waters and ground waters.

Minor schemes and small tanks are as much an engineering problem as major and medium projects. Under present conditions, they are extravagant in water use and virtually not maintained until they fall into dis-use. With the development of new major works, they will create serious drainage problems. Minor schemes and tanks, therefore, now require expert supervisions as much as major and medium schemes; and they have to be merged, wherever possible, into new major projects.

The developments undertaken since 1951 and those proposed, exceed by far, in magnitude and overall effect, the developments undertaken up to 1951. The latter were largely confined to small valleys and the delta areas; the development of the uplands is now being undertaken on an extensive scale for the first time and this will create many new problems.

68. In view of the facts and considerations set out above,

the Commission recommends that the State Governments concerned should all agree to tune their policy regarding irrigation and the administration and management of irrigation works to the requirements of optimum development of a scarce and expensive natural resource.

Some of the steps which should be undertaken immediately in furtherance of this objective are as follows :

(*a*) **Limit the irrigation of paddy to the rainy season, in order to reduce the use of irrigation supplies to the minimum and (*i*) to areas of high rainfall such as sub-basins G. 8, G. 9, G. 10, G. 11 and G. 12 and the narrow strip along the Western Ghats where the delta for paddy should not be more than about 2.0 feet (*ii*) valley-bottoms and low-lying areas where, because of the seepage from upland irrigation no other crop can be grown and paddy can be grown with advantage or (*iii*) to the delta lands.**

(*b*) **Adopt a crop pattern which would (*i*) take full advantage of seasonal rainfall and (*ii*) not require any stored water after February, so that the reservoirs are emptied by that date. This will save the high evaporation loss from March to May.**

(*c*) **Develop the use of ground waters to the maximum; investigate the likely sites and develop the use of under-ground reservoirs, artificially charged during the rainy season.**

(*d*) **Limit perennial crops to (*i*) only those areas where the irrigation supplies required between, say, January to May can be obtained from ground waters or from artificially charged under-ground reservoirs or (*ii*) to those areas where irrigation waters are obtained from the regulated flow below a power project. In such cases, the perennial areas should be in convenient blocks, so that it is not necessary to run any irrigation channel with a capacity factor of less than 0.5 in any month.**

(*e*) **In case of multipurpose projects, the crop pattern should be such as would require irrigation supplies more or less uniformly all the year round,** (*f*) **Reorganise the Public Works Department, where necessary, to enable it to manage all irrigation projects, major, medium, minor or small tanks, and all stages of planning, construction, operation and development including the assessment of water charges. It is necessary that all aspects of the development of water resources for irrigation and of their ultimate use should be under unified control.**

(*g*) **While no control need be exercised, at this stage, with regard to development of irrigation from wells, except where such development is an integral part of a canal system, it is necessary to have in the Irrigation Department, officers to advise cultivators with regard to developments from wells and who should maintain a record of well operations. These officers should also maintain records of the operation of private irrigation works and watch the effect, on the hydrology of the basin, of contour bunding and land treatment in non-irrigated areas.**

(*h*) **Introduce necessary legislation along uniform set of principles to facilitate optimum development of the water resources of the two river basins, laying down appropriate powers for Government and the rights and obligations of the cultivators. A more or less uniform basis for charges for irrigation water supplies and betterment levy *etc.* should be established.**

(*i*) **The present system of administrative account of irrigation projects should be reviewed and revised to take note of the changed conditions, such as the new direct receipts from agricultural commodities or the processing of agricultural produce. An appropriate basis should be established for taking note of indirect benefits in the administrative accounts.**

69. If the use of water supplies is regulated in accordance with the recommendations (*a*) to (*e*) above and the administrative changes suggested in (*f*) above are carried out, the Commission is hopeful that with the available water supplies, with the diversion of surplus Godavari waters into the lower part of the Krishna basin, with the saving in evaporation losses from old tanks as well as new reservoirs, with the regeneration which is likely to result and the salvage in transit losses, it would be possible, in due course, to meet the reasonable requirements of most of the areas proposed to be irrigated by all the projects that have been put forward.

70. **There should be in every Irrigation Department, a soil survey wing, whose duty should be not only to carry out a scientific soil survey of all areas proposed to be supplied with irrigation waters but also, periodically, to carry out soil survey of the areas already under irrigation** in order to study the effect of irrigation supplies on the soil characteristics so that the necessary ameliorative measures can be taken and irrigation ensured as a permanent feature of agriculture.

Need for co-operative approach

71. It is clear from the conclusions reached in various parts of the report and the recommendations made above that optimum development of the water resources of the two river systems would not be possible without a co-operative approach by the States concerned. Close co-ordination in the planning and operation of irrigation and hydro-electric projects, as in other related activities in the two basins, is indispensable. Already, a number of problems have arisen because of the exclusive developments

undertaken hitherto which, unless attended to immediately, would become serious as soon as these developments become operative.

The Commission recommends that an inter-State body, a River Board or by whatever name called, should be established without any delay, for bringing about a co-operative approach and establishing the necessary co-ordination in the planning and operation of various developments in the two river basins. The integrated operation of all projects, which is indispensable, would not be possible without such a co-ordinating body.

Irrigation Extension Service

72. It has been stated in paragraph 67 that the large potential to be created by the projects undertaken since 1951 must be developed not along the lines of earlier developments, undertaken under very different set of conditions, but in full recognition of the changed circumstances. In the Commission's view, the pace of development on works already completed is slow, and in most cases targets have not been achieved, largely due to the fact that the methods being adopted are not adequate to the needs of the situation.

The Commission recommends for serious consideration that, in each State, an Irrigation Extension Service should be introduced as a part of the Irrigation Department.

It is not enough that the Public Works Department should create large irrigation potentials. They must go further and ensure that these potentials are developed, along scientific lines, for maximum national good, keeping in view the requirements of *permanent* irrigated agriculture.

73. The main functions of the proposed Irrigation Extension Service should be :

(*a*) to carry out systematic studies on the economic use of irrigation waters, consistent with maximization of agricultural output; to determine for each region or district the best crop pattern so as to make maximum use of seasonal rainfall; to co-operate with regional research stations of the Agricultural Department in research on new varieties of crops best suited to the nature of irrigation supplies available in any area ;

(*b*) to determine the consumptive use of water by major agricultural and garden crops ;

(*c*) to set up a number of demonstration centres and arrange for field demonstrations to show the cultivators how they can use the available irrigation supplies for maximum benefit, proper land treatment required for each field, proper method of irrigating the field, when to apply irrigation water and how much ;

(*d*) in conjunction with the soil wing, proposed in paragraph 70, advise the cultivators on soil problems.

74. In the Commission's view, an organisation of the type described above, as a part of the irrigation department, is indispensable in the Krishna and Godavari

basins, where large scale irrigation is being introduced in the uplands for the first time, water is scarce and expensive, but irrigation use to date has been somewhat extravagant. The change-over from unirrigated to irrigated agriculture in large areas requires expert guidance and supervision.

75. The proposed Irrigation Extension Service would supplement the present activities of the Agricultural Department. While the Agricultural Department can concentrate on improvements in un-irrigated areas, research on new varieties of crops, both irrigated and un-irrigated, seed multiplication, *etc.*, the Irrigation Extension Service would show the irrigators how irrigation waters can be used economically to maximum advantage, how land must be prepared for irrigation, the importance of water courses and explain to them the inter-relation between irrigation and soil.

N. D. Gulhati
D. D. Jaini
R. C. Hoon

TABLE I—SUB-BASINS

Sub-basin number	*Name of the Sub-basin*	*Area (Square miles)*	*Percentage of basin*
	Krishna River System		
K.1	Upper Krishna	6,939	6·94
K.2	Middle Krishna	6,779	6·78
K.3	Ghataprabha	3,409	3·41
K.4	Malaprabha	4,459	4·46
K.5	Upper Bhima	17,786	17·79
K.6	Lower Bhima	9,478	9·48
K.7	Lower Krishna	13,948	13·95
K.8	Tungabhadra	18,466	18·47
K.9	Vedavati	9,108	9·11
K.10	Musi	4,329	4·33
K.11	Palleru	1,260	1·26
K.12	Muneru	4,019	4·02
	Total	99,980	100·00
	Godavari River System		
G.1	Upper Godavari	12,935	10·71
G.2	Pravara	2,524	2·09
G.3	Purna	6,015	4·98
G.4	Manjra	11,909	9·86
G.5	Middle Godavari	6,643	5·50
G.6	Maner	5,060	4·19
G.7	Penganga	9,227	7·64
G.8	Wardha	9,300	7·70
G.9	Pranhita	23,588	19·53
G.10	Lower Godavari	9,602	7·95
G.11	Indravati	16,087	13·32
G.12	Sabari	7,887	6·53
	Total	120,777	100·00

TABLE II

IRRIGATION DEVELOPMENT FROM THE KRISHNA RIVER SYSTEM AS OF 1951

Name or particulars of schemes	*Average annual irrigation (acres)*	*Average annual diversion (T.M.C.)*
ANDHRA PRADESH		
Krishna Delta system	1,119,900	186·8
Kurnool Cuddapah Canal	97,800	33·0
5 medium schemes	45,300	11·3
106 minor schemes	347,345	59·0
12,617 small tanks and diversions		
Total	**1,610,345**	**290·1**
MAHARASHTRA		
Nira Canals	155,100	32·0
7 medium schemes	48,200	9·9
19 minor schemes	14,961	1·1
16 small tanks and diversions	3,895	
Total	**222,156**	**43·0**
MYSORE		
5 medium schemes	56,300	11·3
86 minor schemes	70,000	67·0
14,109 small tanks and diversions	343,576	
Total	**469,876**	**78·3**
Grand Total	**2,302,377**	**411·4**

TABLE III

IRRIGATION DEVELOPMENT FROM THE GODAVARI RIVER SYSTEM AS OF 1951

Name or particulars of schemes	*Average annual irrigation (acres)*	*Average annual diversion (T.M.C.)*
ANDHRA PRADESH		
Godavari Delta System	1,220,500	253·0
Nizamsagar Project	128,000	40·0
6 medium schemes	40,700	13·3
116 minor schemes	62,866	86·5
15,547 small tanks and diversions	455,675	
Total	**1,908,741**	**392·8**
MADHYA PRADESH		
Wainganga Canal	52,100	5·9
6 medium schemes	27,200	2·0
11 minor schemes	8,800	12·3
9,080 small tanks and diversions	114,360	
Total	**202,460**	**20.2**
MAHARASHTRA		
Godavari Canals	46,600	10·3
Pravara Canals	58,000	15·3
8 medium schemes	84,600	7·1
44 minor schemes	31,144	23·3
7,561 small tanks and diversions	385,250	
Total	**605,594**	**56.0**
MYSORE		
22 small tanks and diversions	1,069	0·2
ORISSA		
15 minor schemes	6,000	1·4
128 small tanks and diversions	11,000	
Total	**17,000**	**1·4**
Grand Total	**2,734,864**	**470·6**

TABLE IV

PARTICULARS OF PROJECTS WHICH HAVE COME INTO OPERATION SINCE 1951

KRISHNA RIVER SYSTEM

Name or particulars of schemes	*Installed power*	*Annual irrigation*		*Annual diversion*	
		Maximum to-date	*Ultimate proposed*	*Maximum to-date*	*Ultimate proposed*
	kW.	....Acres....		....T.M.C.....	
ANDHRA PRADESH					
Tungabhadra Project . . .	63,000*	105,400	156,900	82·6*	135·2*
Rajolibanda Diversion Scheme .		16,400	87,000	10·4*	17·1*
Musi Project		6,000	52,600	2·3	8·4
2 medium schemes . .		18,500	31,500	7·0	7·5
21 minor schemes . . .		11,625	20,000	7·7	11·7
Small tanks and diversions . .		34,219	50,000		
Total . . .	**63,000***	**192,144**	**398,000**	**110·0****	**179·9****
MAHARASHTRA					
Radhanagari Project . . .	4,800	19,700	20,000	6·5	6·5
Ghod Dam Project . . .		15,100	62,400	0·7	8·4
3 medium schemes . .		18,300	30,600	1·8	2·7
30 minor schemes . . .		22,031	45,000	1·8	3·5
Small tanks and diversions . .		7,241	12,000		
Total	**4,800**	**82,372**	**170,000**	**10·8**	**21·1**
MYSORE					
Ghataprabha Project . . .		56,400	298,000	**10·0**	**34·8**
Tungabhadra Project . . .	See under Andhra Pradesh.	177,200	672,300		
Rajolibanda Diversion Scheme .		3,700	5,900		
Bhadra Reservoir Project . .	33,200	17,900	241,600	6·7	56·8
1 medium scheme . .		17,000	27,200	5·8	8·8
33 minor schemes . . .		25,569	50,000	4·3	9·3
Small tanks and diversions . .		2,657	4,000		
Total . . .	**33,200**	**300,426**	**1,299,000**	**26·8**	**109·7**
Grand Total . . .	**101,000**	**574,942**	**1,867,000**	**147·6**	**310·7**

**includes Mysore's share.*

***includes Mysore's share of Tungabhadra Project and Rajolibanda Diversion Scheme.*

TABLE V

PARTICULARS OF PROJECTS WHICH HAVE COME INTO OPERATION SINCE 1951

GODAVARI RIVER SYSTEM

Name or particulars of schemes	*Installed power*	*Annual irrigation*		*Annual diversion*	
		Maximum to-date	*Ultimate proposed*	*Maximum to-date*	*Ultimate proposed*
	kW.	....acres....		....T.M.C.....	
ANDHRA PRADESH					
Nizamsagar Hydro-electric Scheme	15,000			*35·0*	*55·8*
Kaddam Project		5,000	85,000	1·0	16·2
Machkund Hydro-electric Scheme	114,750			*33·2*	*44·2*
3 minor schemes		2,052	5,000	11·7	14·2
1,815 small tanks and diversions .		67,948	80,000		
Total	**129,750**	**75,000**	**170,000**	**12·7**	**30·4**
MADHYA PRADESH					
3 medium schemes . . .		13,400	23,800	1·5	1·8
7 minor schemes		4,007	6,000	1·0	1·2
36 small tanks and diversions .		6,680	8,000		
Total		**24,087**	**37,800**	**2·5**	**3·0**
MAHARASHTRA					
Gangapur Project . . .		5,200	44,000	1·4	7·4
1 medium scheme . . .		6,100	7,500	0·4	0·5
7 minor schemes		858	5,000	0·3	0·6
105 small tanks and diversions .		4,711	6,000		
Total		**16,869**	**62,500**	**2·1**	**8·5**
MYSORE			Nil		
ORISSA					
Machkund Hydro-electric Scheme					
5 minor schemes		4,261	4,261	1·5	1·5
116 small tanks and diversions .		13,679	13,679		
Total		**17,940**	**17,940**	**1·5**	**1·5**
Grand Total	**129,750**	**133,896**	**288,240**	**18·8**	**43·4**

TABLE VI

PARTICULARS OF PROJECTS UNDER CONSTRUCTION

KRISHNA RIVER SYSTEM

Name or particulars of schemes	*Proposed installed power*	*Proposed annual irrigation*	*Proposed annual diversion*
	kW.	*acres*	T. M. C
ANDHRA PRADESH			
Nagarjunasagar	..	2,000,000	263·6
Tungabhadra Project High-level Canal—Stage I .	..	189,400*	28·8*
Tungabhadra Hydro-electric Project—Stage II .	27,000**	..	..
3 minor schemes	..	6,105	1·2
4 small tanks and diversions	..	1,217	
Total	**27,000****	**2,196,722***	**293·6***
MAHARASHTRA			
Koyna Hydro-electric Project—Stages I and II .	580,000	..	67·5
Khadakwasla Project—Stage I . . .	..	77,000	17·5
Vir Dam Project	..	101,000	14·4
4 medium schemes	..	33,500	2·2
23 minor schemes	..	34,142	2·6
32 small tanks and diversions	..	6,081	
Total	**580,000**	**251,723**	**104.2**
MYSORE			
Tungabhadra High Level Canal Project—Stage I	See under Andhra Pradesh		
Tungabhadra Hydro-electric Project—Stage II .			
7 medium schemes	..	49,300	5·3
31 minor schemes	..	28,493	5·8
120 small tanks and diversions	..	22,446	
Total	..	**100,239**	**11·1**
Grand Total	**607,000**	**2,548,684**	**408·9**

**includes Mysore's share of Tungabhadra Project High Level Canal—Stage I*

***includes Mysore's share of Tungabhadra Hydro-electric Project—Stage II*

TABLE VII

PARTICULARS OF PROJECTS UNDER CONSTRUCTION

GODAVARI RIVER SYSTEM

Name or particulars of schemes	*Proposed installed power*	*Proposed annual irrigation*	*Proposed annual diversion*
	kW.	*acres*	T. M. C.
ANDHRA PRADESH			
Upper Sileru Hydro-electric Project—Stage I	120,000	..	*56·8*
2 medium schemes	..	24,500	4·1
6 minor schemes	..	18,050	3·1
11 small tanks and diversions	..	347	
Total	**120,000**	**42,897**	**7·2**
MADHYA PRADESH			
2 medium schemes	..	20,800	1·6
4 minor schemes	..	1,633	0·7
31 small tanks and diversions	..	4,937	
Total	..	**27,370**	**2·3**
MAHARASHTRA			
Mula Project	..	231,400	31·8
Purna Project	15,000	152,000	28·1
14 medium schemes	..	162,200	14·9
30 minor schemes	..	49,075	2·6
50 small tanks and diversions	..	6,074	
Total	**15,000**	**600,749**	**77·4**
MYSORE		Nil	
ORISSA			
1 medium scheme	..	18,600	1·3
24 minor schemes	..	29,580	5·0
31 small tanks and diversions	..	8,364	
Total	..	**56,544**	**6·3**
Grand Total	**135,000**	**727,560**	**93·2**

TABLE VIII

REVIEW OF ESTIMATED YIELD AND PROJECT REQUIREMENTS AS PROPOSED BY STATE GOVERNMENTS

Name of Sub-basin	*Estimated direct annual yield from sub-basin**	*Receives inflow from*	*Diversion and losses by projects*			
			as in 1951	*Undertaken since* 1951	*sum of col.* 4 *and col.* 5	*Proposed*†
1	2	3	4	5	6	7
	T.M.C.		....	T.M.C.	....	
	Krishna	**River System**				
K. 1 Upper Krishna	550·0	..	2·2	86·6	88·8	436·8
K. 2 Middle Krishna	35·0	K.1, K.3, K.4	1·8	4·8	6·6	404·6
K. 3 Ghataprabha	190·0	..	3·0	38·8	41·8	116·8
K. 4 Malaprabha	70·0	..	9·7	5·6	15·3	45·9
K. 5 Upper Bhima	400·0	..	89·8	58·6	148·4	207·6
K. 6 Lower Bhima	55·0	K.5	6·2	5·3	11·5	168·0
K. 7 Lower Krishna (up to Vijayawada)	210·0	K.2, K.6, K.8, K.10, K.11, K.12	258·9	315·1	574·0	1,315·1
K. 8 Tungabhadra	520·0	K.9	124·4	292·3	416·7	161·6
K. 9 Vedavati	50·0	..	48·1	8·3	56·4	
K.10 Musi	50·0	..	32·2	16·5	48·7	3·2
K.11 Palleru	17·0	..	15·5	2·1	17·6	1·2
K.12 Muneru	70·0	..	57.5	5·7	63·2	17·80
	Godavari	**River System**				
G. 1 Upper Godavari	240·0	G.2 and G.3	14·0	18·0	32·0	161·0
G. 2 Pravara	70·0	..	17·0	35·0	52·0	15·0
G. 3 Purna	100·0	..	..	39·0	39·0	34·0
G. 4 Manjra	270·0	..	102·0	11·0	113·0	133·0
G. 5 Middle Godavari	100·0	G.1,G.4 and G.6	39·0	29·0	68·0	500·0
G. 6 Maner	90	..	57·0	11·0	68·0	29·0
G. 7 Penganga	180	..	1·0	2·0	3·0	121·0
G. 8 Wardha	240	G.7	5·0	5·0	10·0	91·0
G. 9 Pranhita	1,300	G.8	104·0	9·0	113·0	714·0
G.10 Lower Godavari (up to Dowlaishwaram)	400	G.5, G.9, G.11 and G.12	258·0	12·0	270·0	713·0
G.11 Indravati	1,160	..	8·0	7·0	15·0	378·0
G.12 Sabari	480	..	4·0	11·0	15·0	269·0

**The Commission regards these estimates as no better than informed guesses; while giving a general idea of the likely average yield from each sub-basin, these estimates are not enough to form the basis of big projects involving large sums of public money. Considerable caution must be exercised in sanctioning new projects.*

†*See paragraph* 58.

M 8 I&P 62—18-3-63—3000—(Sec. IV)—GIPF.